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Abstract

THE BROOKHAVEN HIGH FLUX BEAM RESEARCH REACTOR

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The High Flux Beam Reactor (HFBR) has been designed and constructed to meet current needs in neutron physics and chemistry research at Brookhaven. Sixteen experimental facilities have been provided in the reactor. Seven of these are irradiation facilities, four for fast neutron exposures, and three for thermal neutron exposures. Nine beam tubes are provided in the reactor vessel and shield for the extraction of external neutron beams. The reactor core, reflector, and beam tubes are arranged to enhance the low energy neutron flux in the beams, while decreasing the fast neutron background.

Double polarization experiments, "cold" neutron studies of liquids and solids, and capture gamma ray spectroscopy with the samples in an external beam will all benefit particularly from the large beam intensity and low background of the reactor. Other experiments planned for the initial operating period include two and three crystal diffraction studies, polarized neutron experiments with magnetic materials, and fast chopper experiments with a new three-rotor apparatus.

The HFBR is moderated, reflected, and cooled by D_2O. The fuel is fully-enriched uranium, alloyed with aluminum and silicon, and clad with a wrought magnesium-silicon-aluminum alloy. The fuel elements are of the pressure-tube type, with curved fuel plates. At the normal operating power of 40 MW the maximum fuel element heat flux is 1.6×10^6 Btu/hr-ft^2, the maximum fuel plate surface temperature is 360F, and the maximum thermal neutron flux in the region of the beam tubes is 7×10^{14} n/cm^2-sec. The coolant velocity in the fuel element water channels is 35 ft/sec. The total coolant circulation rate is 16 600 gpm, with a core inlet temperature of 120F and a system pressure 200 psig. The reactor is controlled by 16 angle-shaped neutron-absorbing blades located outside the active core. Neutron flux perturbations

at the experimental facilities are minimized by operating half of the control blades above the core and half below, in positions which are symmetrical with regard to the core center.

The reactor vessel is constructed of a magnesium-silicon-aluminum alloy to design conditions of 275 psig pressure and temperatures of 400F for the beam tubes and 250F for the main vessel wall. The beam tubes are of the same alloy as the vessel and are welded permanently in place. The vessel head is of stainless steel. The reactor is housed in a three-level steel building, hemispherical in shape with a diameter of 176 ft - 8 in. All reactor operations, as well as the handling of samples from the irradiation facilities are carried out on the upper and lower levels, leaving the external beam experimental area on the middle level free of radioactive contamination and unnecessary traffic.